

Claims

1. A particle comprising a core of the metallic element tungsten optionally together with other metallic elements wherein said core is coated with a coating layer.
2. A particle as claimed in claim 1 of a diameter in the range of 1.5 to 20 nm.
3. A particle as claimed in claims 1 and 2 of a diameter in the range of 1.5 to 15 nm.
4. A particle as claimed in claims 1 to 3 of a diameter in the range of 1.5 to 7 nm.
5. A particle as claimed in claims 1 to 4 of a diameter in the range of 2 to 6 nm.
6. A particle as claimed in any of the preceding claims wherein the core of the particle has a tungsten content of 20 to 100 weight% of metallic tungsten.
7. A particle as claimed in any of the preceding claims wherein the core of the particle has a tungsten content of 50 to 100 weight% of metallic tungsten.
8. A particle as claimed in any of the preceding claims wherein the core of the particle has a tungsten content of 85 to 100 weight% of metallic tungsten.
9. A particle as claimed in any of the preceding claims wherein the core of the particle has a tungsten content of 95 to 100 weight% of metallic tungsten.
10. A particle as claimed in any of the preceding claims wherein the core of the particles has a tungsten content of about 100 weight% of metallic tungsten.
11. A particle as claimed in any of the preceding claims wherein the core of the particle comprises metallic tungsten and one or more of the elements rhenium, iridium, niobium, tantalum or molybdenum in their metallic form.
12. A particle as claimed in any of the preceding claims wherein the coating layer comprises a charged coating layer.

13. A particle as claimed in claim 12 wherein the charged coating layer provides a net positive or negative charge at the pH of the environment where the particle is administered.
- 5 14. A particle as claimed in any of claims 12 to 13 wherein the charged coating layer provides a negative charge at the pH of the environment where the particle is administered.
- 10 15. A particle as claimed in any of claims 12 to 14 wherein the charged coating layer provides the net negative charge of acidic groups such as carboxylic acid groups, sulphonic acid groups, phosphoric acid groups and acidic heterocyclic groups.
- 15 16. A particle as claimed in claims 12 to 13 wherein the charged coating layer provides the net positive charge of basic amino, amidine, guanidine, quaternary ammonium and phosphonium groups.
17. A particle as claimed in any of claims 12 to 16 wherein the charged coating layer comprises up to 50 charges per particle.
- 20 18. A particle as claimed in any of claims 12 to 17 wherein the charged coating layer comprises up to 40 charges per particle.
- 25 19. A pharmaceutical as claimed in any of claims 12 to 18 wherein the charged coating layer comprises up to 25 charges per particle.
20. A particle as claimed in any of claims 12 to 19 wherein the charged coating layer comprises at least 8 charges per particle.
- 30 21. A particle as claimed in any of claims 12 to 20 wherein the charged coating layer comprises at least 4 charges per particle.
22. A particle as claimed in any of claims 12 to 21 wherein the layer comprises a polymeric layer with charged groups.
- 35 23. A particle as claimed in claim 22 wherein the polymeric layer comprises a hydrophilic polymer.

24. A particle as claimed in any of claims 22 to 23 wherein the polymer comprises a homopolymer.
- 5 25. A particle as claimed in any of claims 22 to 24 wherein the polymer comprises a copolymer.
26. A particle as claimed in any of claims 22 to 25 wherein the polymer is formed from acrylic acid monomers.
- 10 27. A particle as claimed in any of claims 22 to 26 wherein the polymer is formed from at least one monomer containing a charged group.
28. A particle as claimed in any of claims 22 to 27 wherein the polymer is formed from at least one neutral monomer.
- 15 29. A particle as claimed in any of claims 22 to 28 wherein the molar ratio between the neutral monomer and the charged monomer as below 20:1.
30. A particle as claimed in claim 29 wherein the molar ratio between the neutral monomer and the charged monomer is between 10:1 and 10:1.5.
- 20 31. A particle as claimed in any of claims 1 to 11 wherein the layer comprises a monomeric layer.
- 25 32. A particle as claimed in claim 31 wherein the monomeric layer comprises a hydrophilic monomeric layer.
33. A particle as claimed in claim 32 wherein said hydrophilic layer comprises at least a fraction of molecules that are hydrophilic.
- 30 34. A particle as claimed in any of the claims 31 and 32 wherein said hydrophilic layer comprises molecules that each has at least one hydrophilic group.
- 35 35. A particle as claimed in any of the claims 1 to 11 and 31 and 32 wherein said core is coated with a mono-layer coating.

36. A particle as claimed in claim 35 wherein said mono-layer coating comprises compounds of formula $A_n-L_o-M_p$, where A is one or more tungsten coordinating groups, L is absent or is one or more linking groups and M is one or more hydrophilic groups, n and p are positive integers and o is zero or a positive integer.
37. A particle as claimed in any of claims 31 to 36 wherein the monomeric layer comprises a charged coating layer.
38. A particle of claim 37 wherein the charged coating layer comprises the charged groups of claims 13 to 21.
39. A pharmaceutical comprising particles of the preceding claims optionally together with a pharmaceutically acceptable solvent or excipient.
40. A diagnostic agent comprising particle as claimed in claims 1-38 optionally together with a solvent or excipient.
41. An X-ray contrast agent comprising a particle as claimed in claims 1-38 optionally together with a solvent or excipient.
42. Use of particles of claims 1 to 38 as in vivo contrast agents
43. Use of particles of claims 1 to 38 as X-ray contrast agents
44. A method of diagnosis comprising administration of particles of claims 1 to 38 to a human or animal body, examining the body with a diagnostic device and compiling data from the examination.
45. A method of imaging, specifically X-ray imaging comprising administration of particles of claims 1 to 38 to a human or animal body, imaging the body with an imaging device, compiling data from the examination and optionally analysing the data.
46. A process for the preparation of particles of claims 1 to 30 comprising decomposing a source of tungsten (0) in a high boiling, dried and deoxygenated

solvent in the presence of one or more monomers and thereby effecting a thermally induced polymerization of the monomers.

5 47. A process as claimed in claim 46 wherein the source of tungsten (0) is tungsten hexacarbonyl ($W(CO)_6$).

48. A process as claimed in claims 46 and 47 wherein the solvent comprises di- and triglyme, diphenyl ether, trialkyl phosphine oxide and trialkyl phosphine.

10 49. A process as claimed in claim 48 wherein the solvent comprises trioctyl phosphine oxide and trioctyl phosphine.

15 50. A process as claimed in claims 46 to 49 wherein the high boiling, dried and deoxygenated solvent further comprises a fraction of a lower boiling solvent.

51. A process as claimed in claim 50 wherein the fraction of a lower boiling solvent comprises between 5 to 15 volume% of cyclooctane and/or n-heptane.

20 52. A process as claimed in claims 46 to 51 further comprising work -up of the formed particles from a low-boiling alkane, specifically from pentane.

25 53. A process as claimed in claims 46 to 52 wherein one or more of the monomers comprises silylether-protected polar groups and where the protecting groups are cleaved off in aqueous solution to yield hydrophilic polymer coated particles.